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(71) Applicant
Quartzcolor Ianiro S.p.A.

(Incorporated in Italy)

No 80 Via Cermenati, Rome, Italy

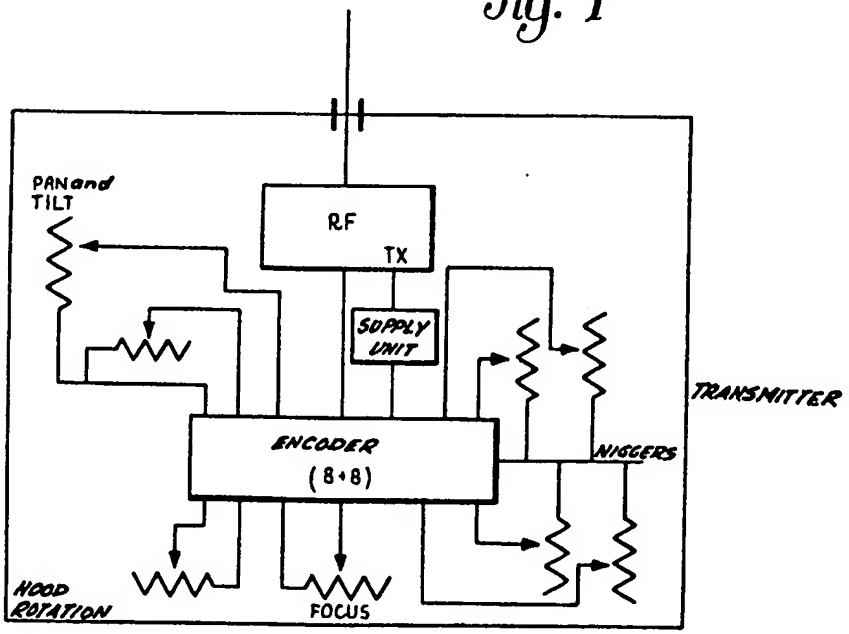
(72) Inventor
Marcello Bertozzi

(74) Agent and/or Address for Service
Boult, Wade & Tennant,
27 Furnival Street, London EC4A 1PQ

(54) Remote control of lighting apparatus

(57) Apparatus for remotely controlling position, focusing etc. of theatre lighting apparatus has command input generators (eg. potentiometers) which emit commands proportional to their movement. The commands may be transmitted by radio to the lighting apparatus.

Fig. 1



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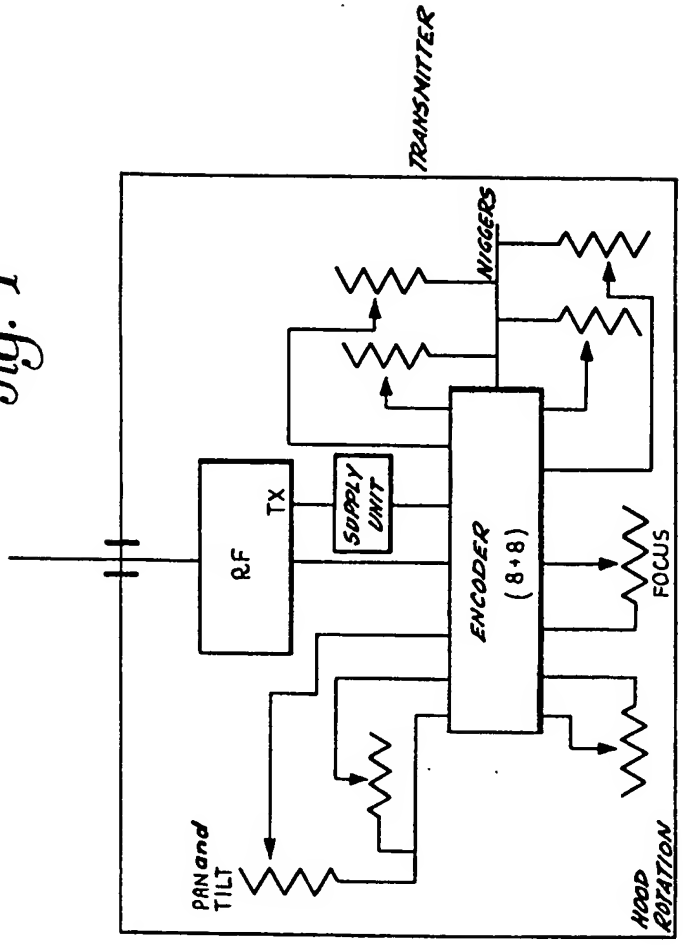
The drawing(s) originally filed was/were informal and the print here reproduced is taken from a later filed formal copy.

Fig. 1


TRANSMITTER
NIGGERS
RF
TX
SUPPLY UNIT
ENCODER (8+8)
FOCUS
PAN and TILT
HOOD ROTATION

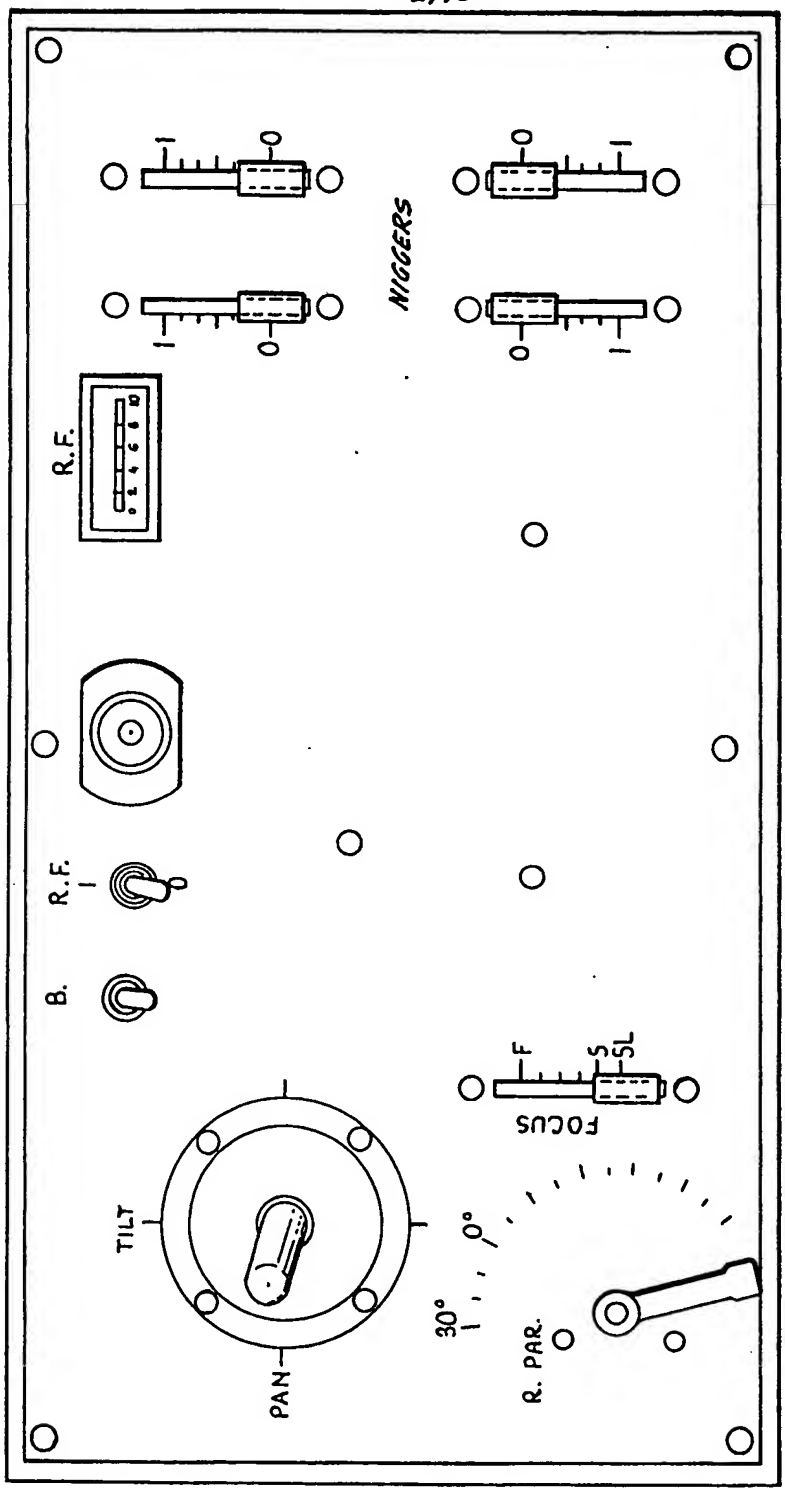


Fig. 2

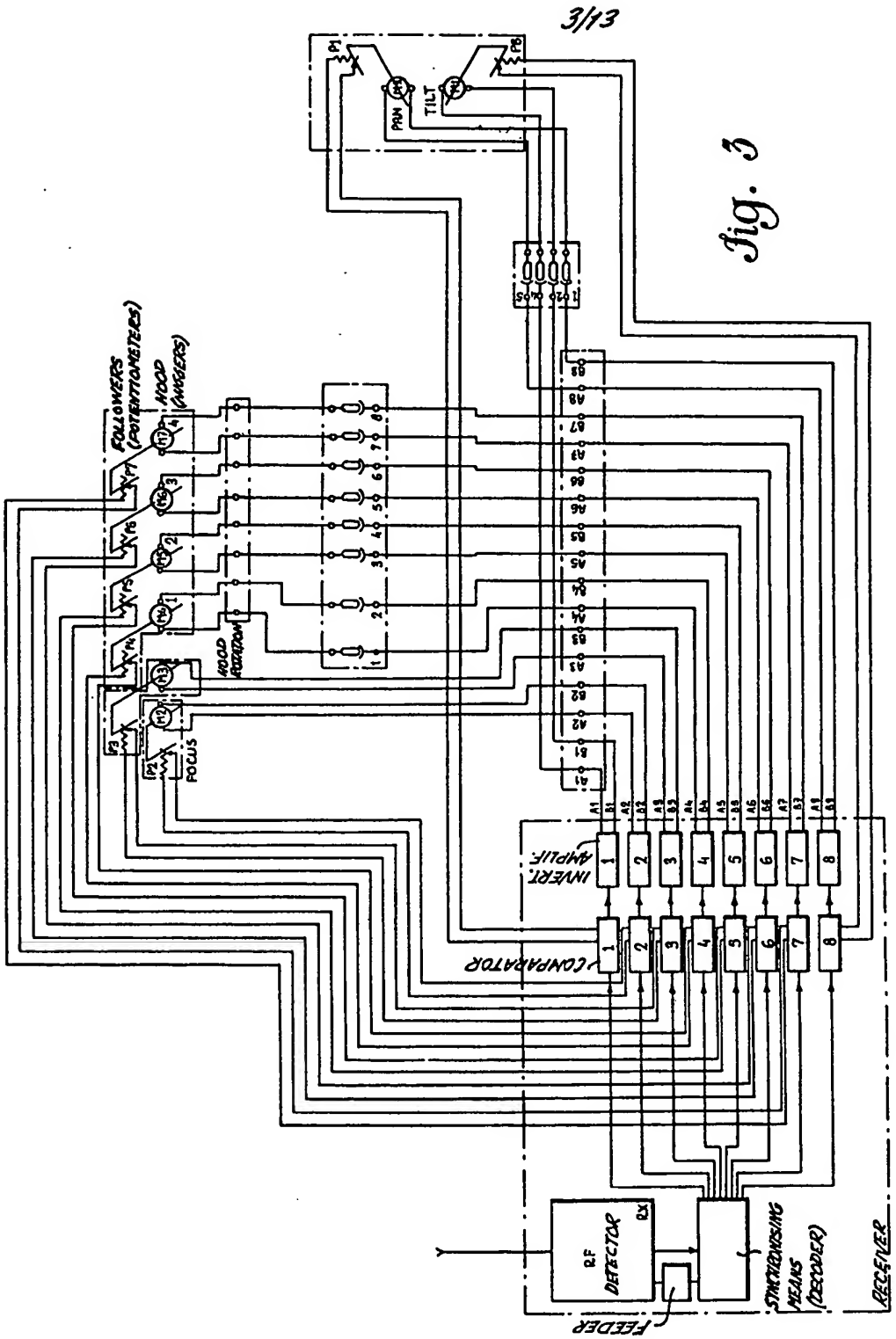
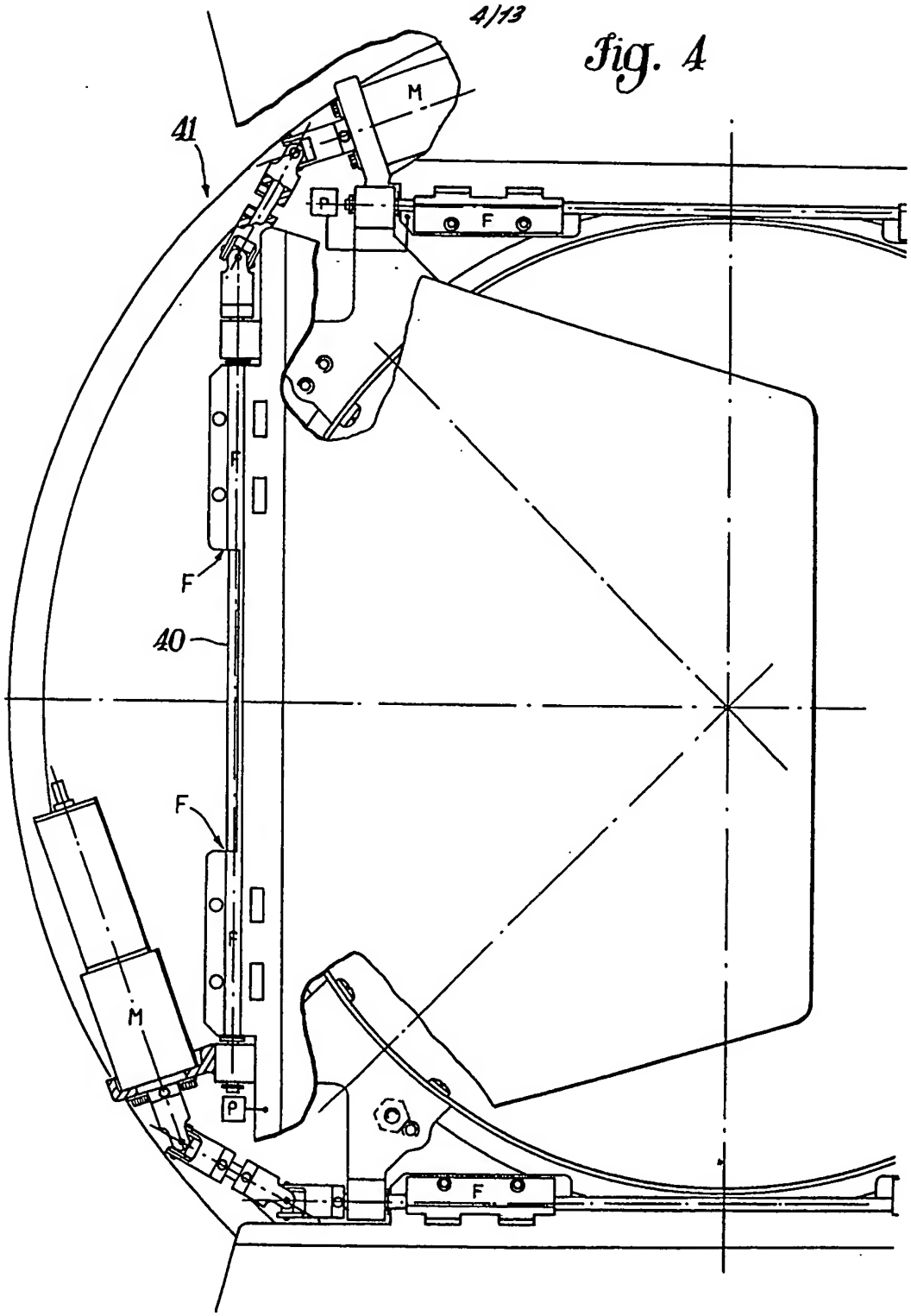

PAN
TILT
FOLLOWERS (POTENTIOMETERS)
HOOD (ANGLES)
HOOD ROTATION
FOCUS
INVERT. AMPLIF.
COMPARATOR
R.F DETECTOR
DX
STROBOSCOPIC MEANS (DECODER)
RECEIVER
FEEDER

Fig. 3

Fig. 4



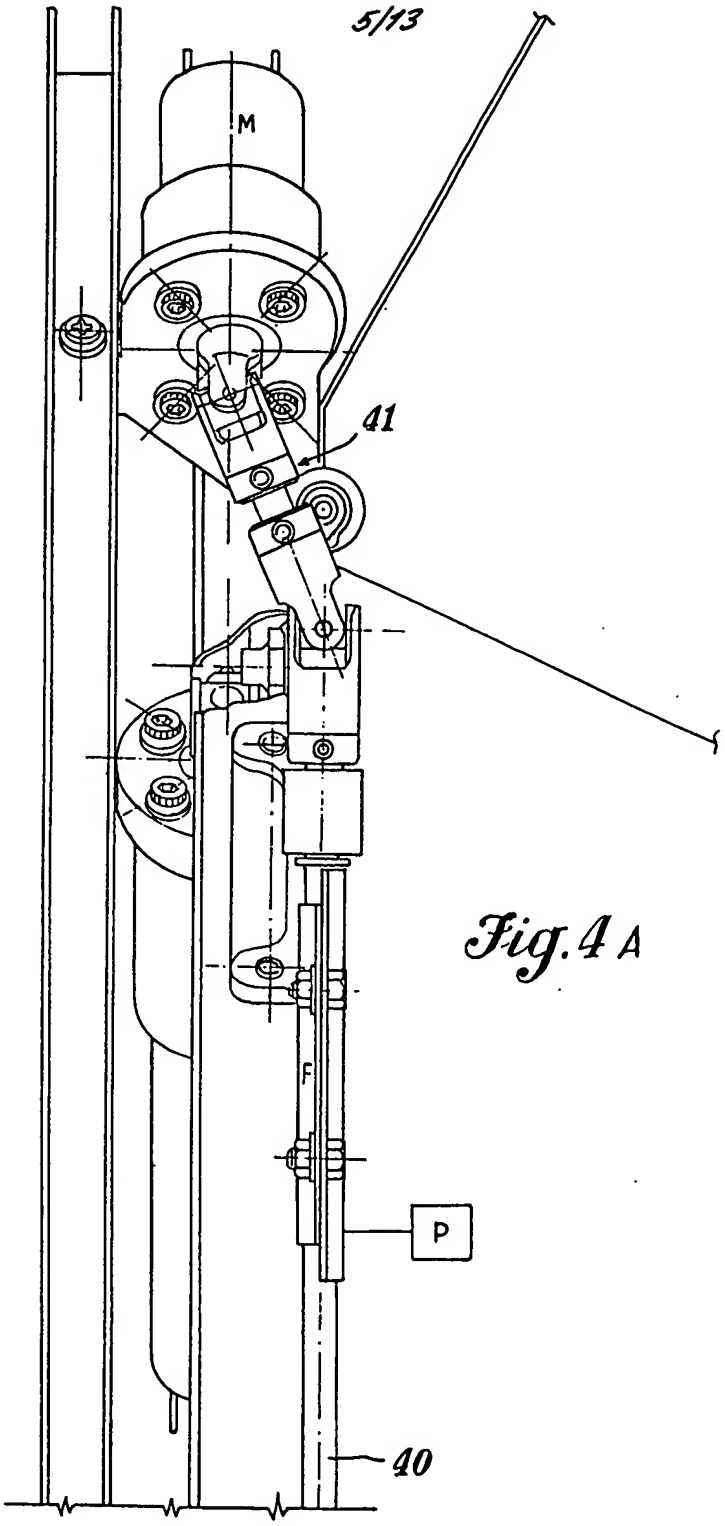


Fig. 4 A

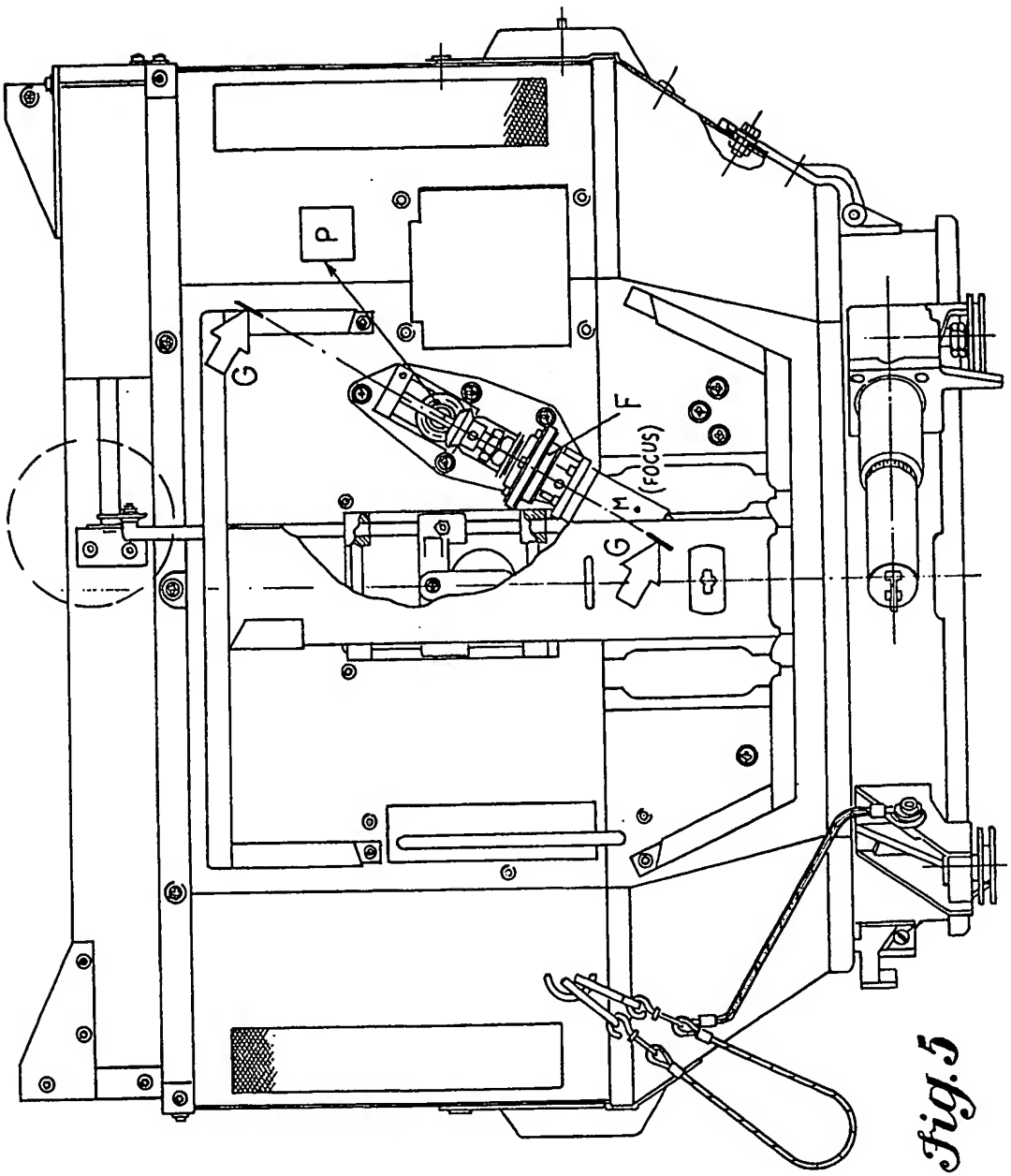


Fig.5

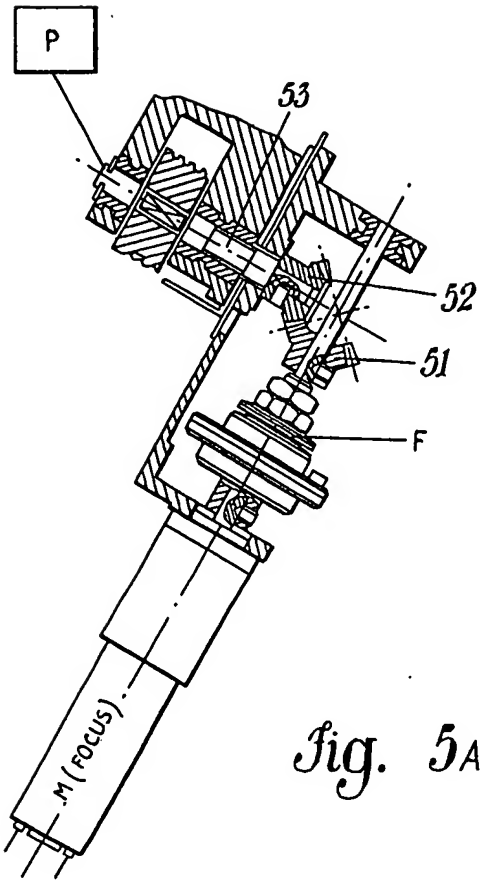


Fig. 5A

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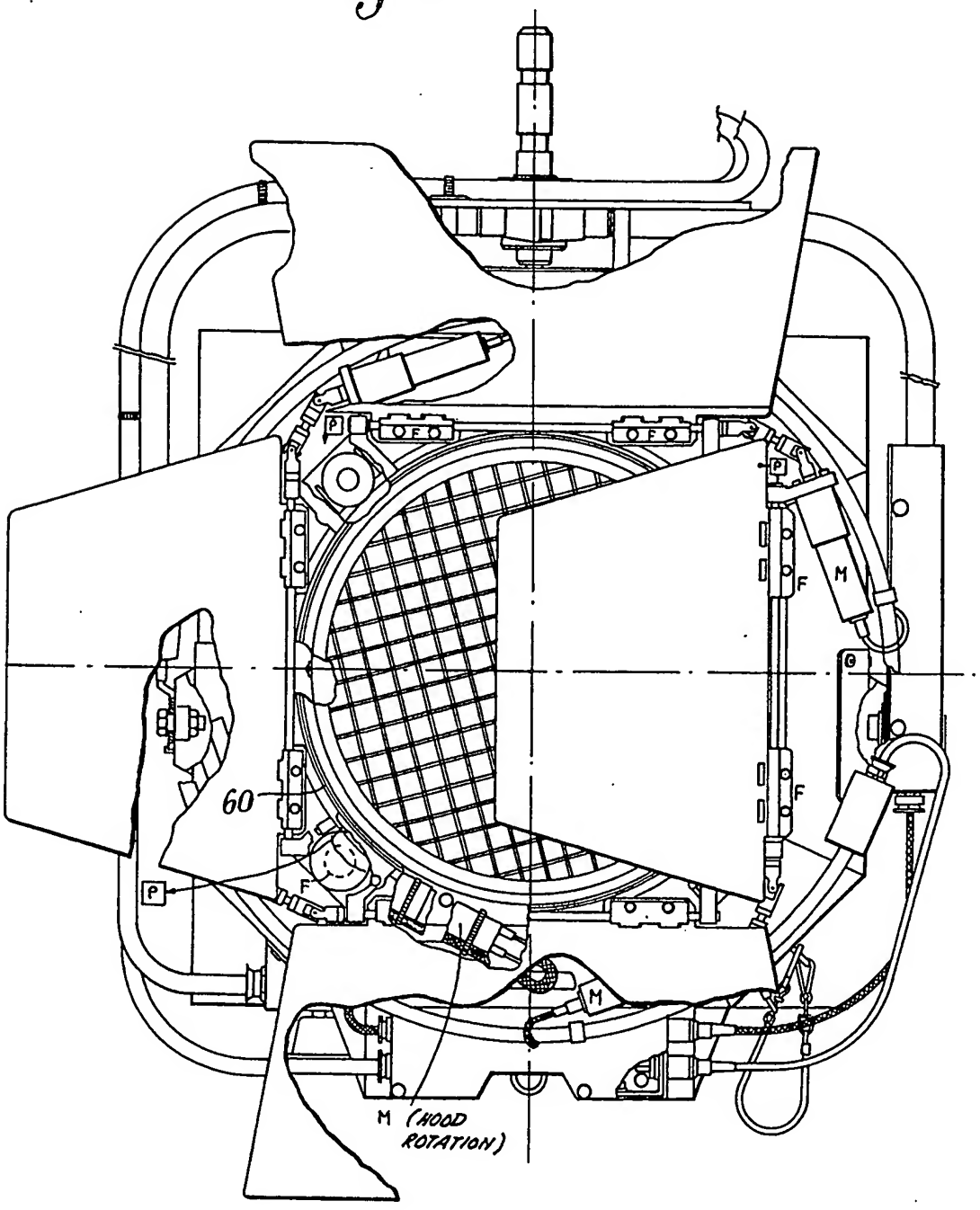
Fig. 6



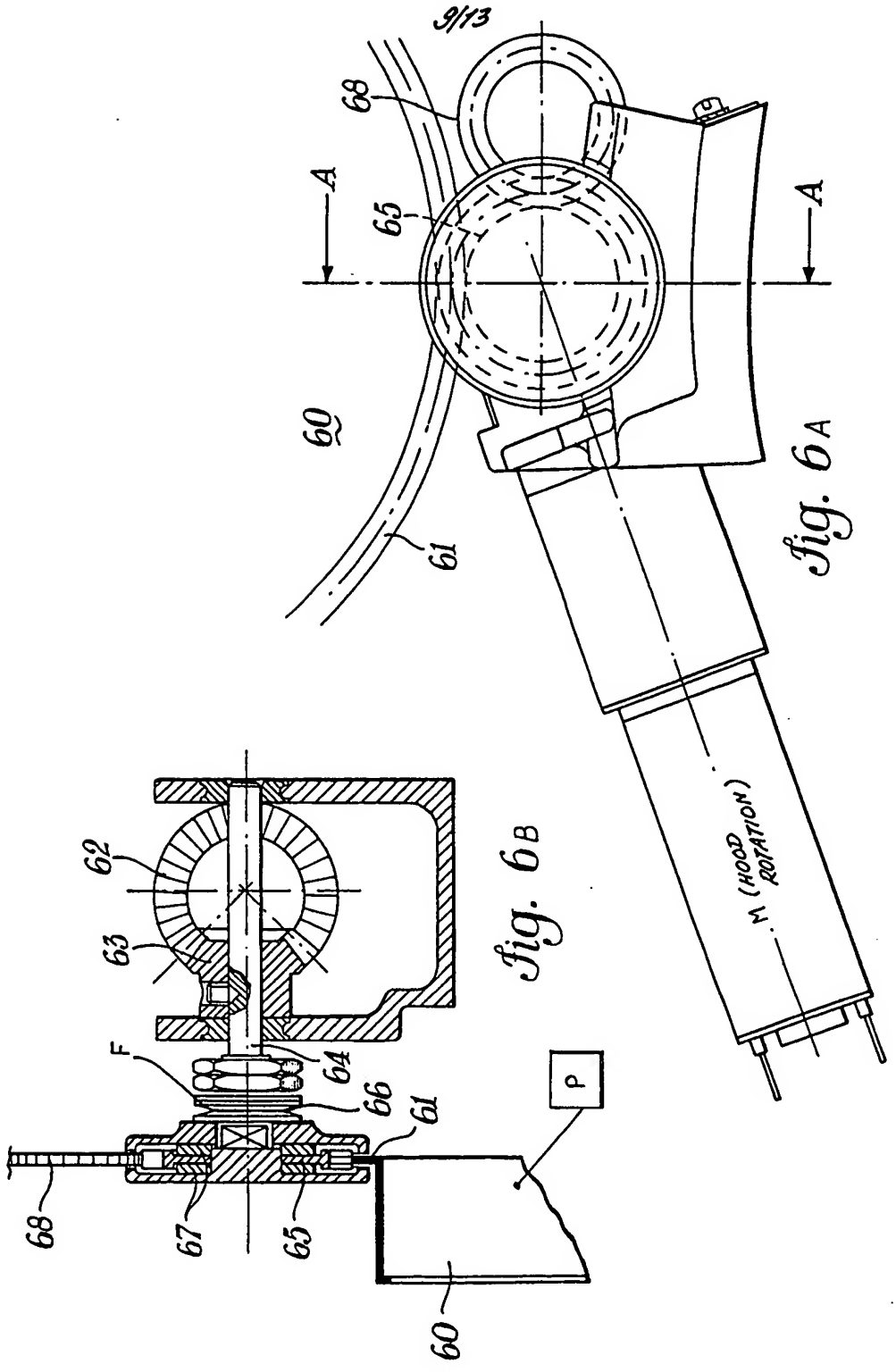


Fig. 6A

Fig. 6B

Fig. 7

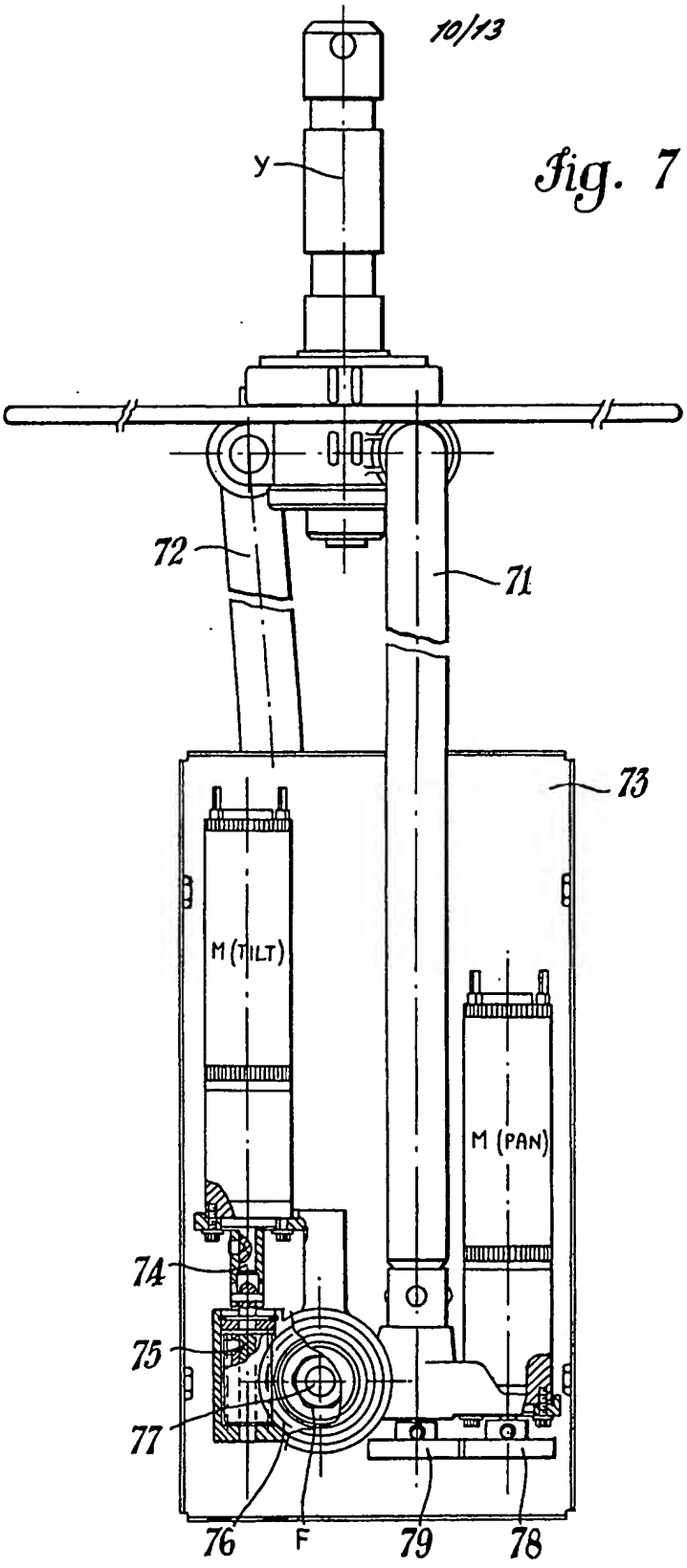


Fig. 7A

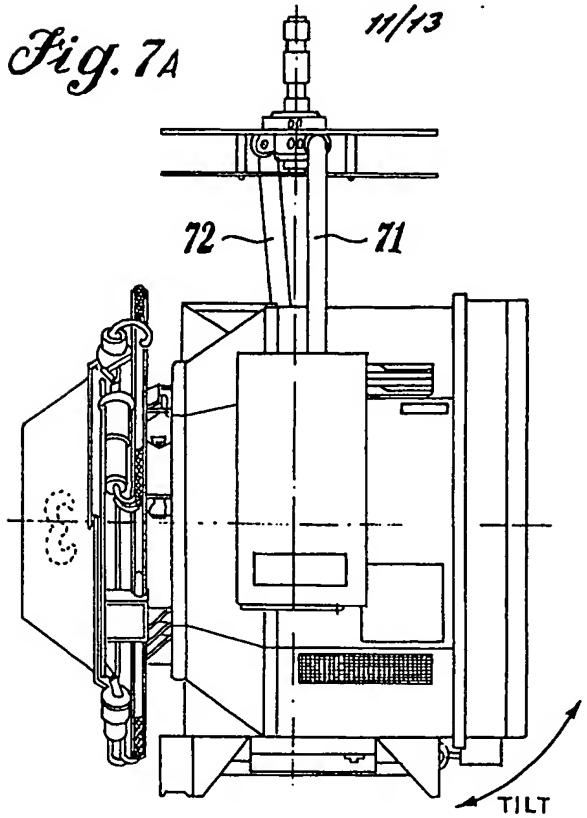
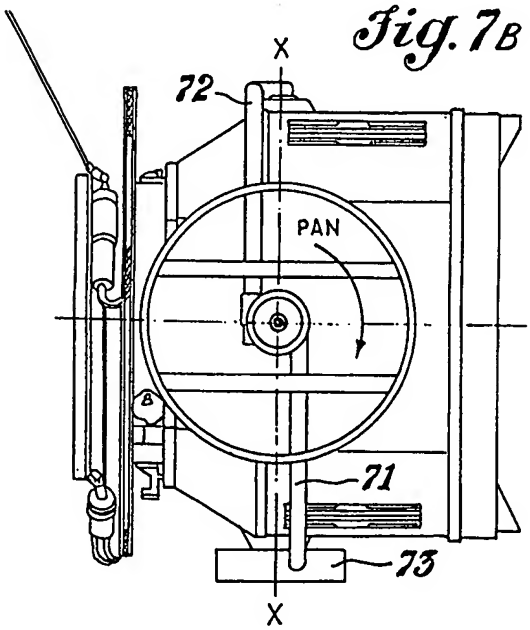


Fig. 7B



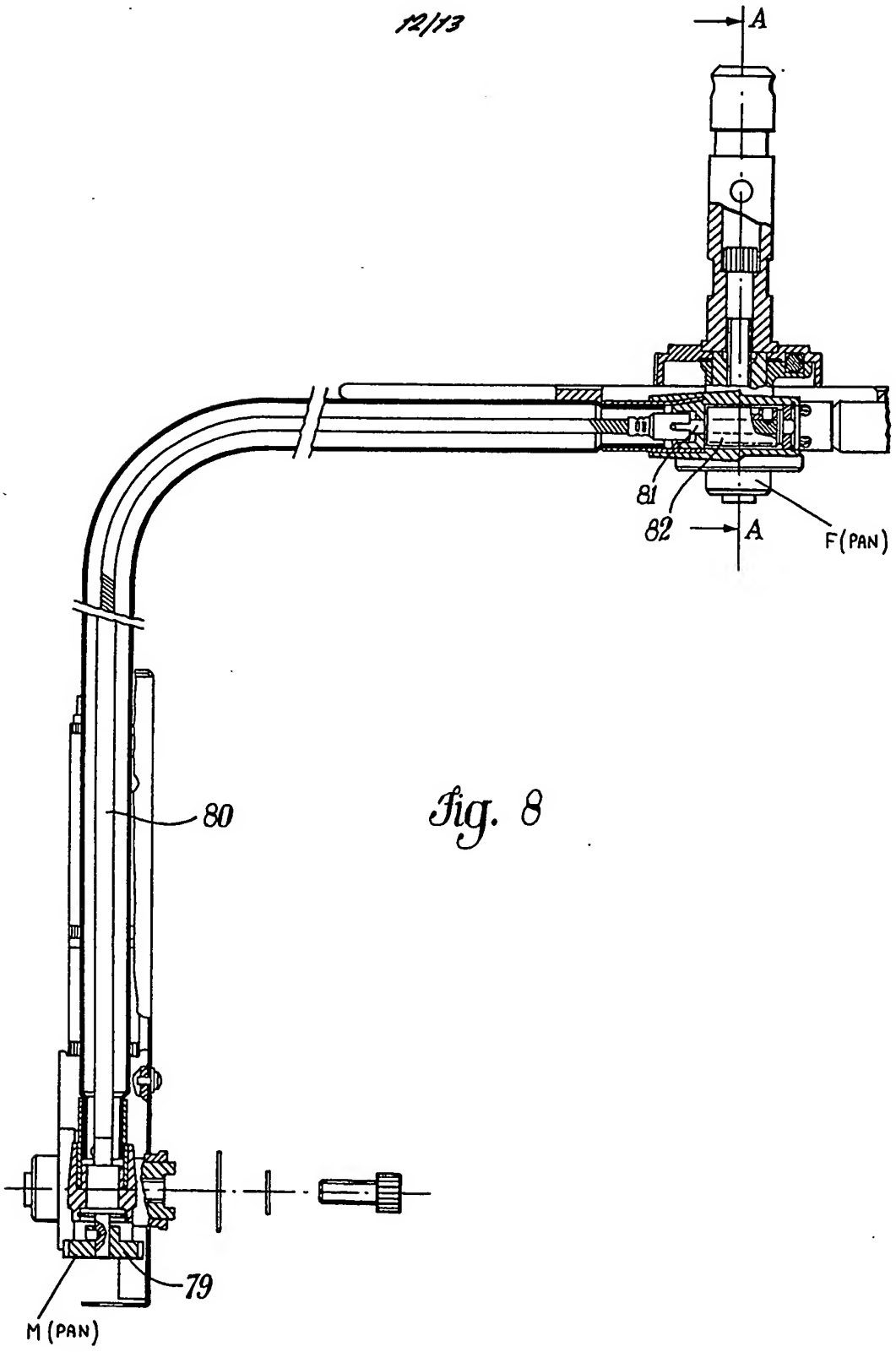


Fig. 8

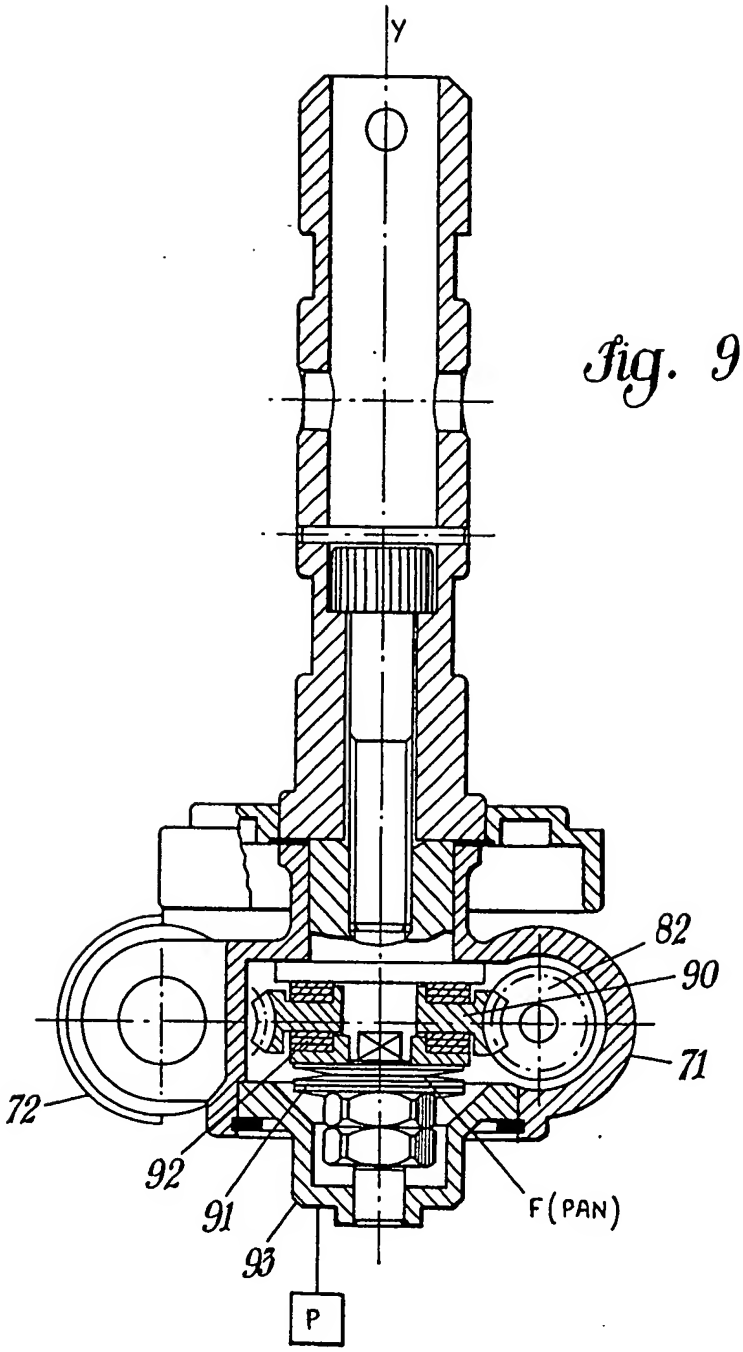


Fig. 9

SPECIFICATION

Lighting apparatus

The present invention relates to a lighting apparatus which is particularly suitable for use in theatres, photographic, motion picture and television studios, and the like.

As is well known, lighting apparatus is employed in theatres, in photographic, motion picture and television studios, and the like, such lighting apparatus being a fundamental component of the whole set. The importance of the lighting apparatus is stressed by the existence of a lighting manager who is responsible for the management of the whole system and gives an important contribution to, for example, the direction of a film or to the production of a theatre performance.

One of the fundamental components of a complete lighting system is the lighting projector. Such apparatus is well known and can be mounted at various heights to perform the following functions or operative motions.

Known lighting apparatus is able to supply two types of lighting namely the so-called "spot" or concentrated type, and the so-called "soft" or diffused type. The two lighting types are emitted from two opposed sides of the lighting projector, which are thus called the "spot side" and the "soft side", and a 180° rotation of the lighting projector is required for switching from one type to the other.

The switching from a given lighting type to the other requires a combination of two motions inside the projector, and, more precisely, in one embodiment of projector, rotation of a concave mirror with respect to a bulb and shift of a carriage carrying the bulb, relative to the mirror, for focussing purposes. Such a combined motion is called "focus" motion and it is performed by means of a single motor.

A lighting projector can be hung at a required height by means of two arms forming an inverted U shape. Two motions of the lighting projector when mounted within the two arms of the inverted U are possible. The first motion consists in rotation of the whole assembly of the lighting projector and the two arms about the longitudinal axis of the U-shaped support through its suspension point. Such rotation motion which can be through a 360° arc and in both senses, is called the panoramic or "pan" motion.

A further motion is that of rotation performed by the lighting projector only about the axis that goes from the end f one arm to the end of the other arm of the U-shaped support. Such m tion is called the inclining or "tilt" motion.

The lighting projector can have a hood assembly comprising a circular framework which can r tate about its central axis and has four flaps hinged at the four sides of a square circumscribed to the hood framework. Such hinged flaps are called niggers and they can be moved about their hinge axes. Thus, a rotatory motion of the hood framework is possible, such motion being called rotation of the hood, and four independent motions of the niggers about their hinge axes are possible, such motions resulting in the closing or opening of the niggers.

Summarizing the above, eight independent motions are possible during the operation of the lighting apparatus, these being:

a) the inclining or tilt motion,
b) the panoramic or pan motion,
c) the focussing or focus motion,
d) the rotation motion of the hood,
e) f) g) h) four rotation motions of the four niggers.

As such motions must possibly be performed independently of one another, due to the lighting requirements of the scene, eight independent drive arrangements are needed, each one with a separate control and regulation system.

Those who are skilled in the art know the many problems that are involved in the management of a lighting system of this kind, which problems can at the present time be solved only by manual intervention, this requiring personnel, and sometimes many personnal.

Just a short mention can be made of the very large range of situations that can occur as a result of the very different requirements of a scene being lit, the requirements asking for a combined operation of a large number of lighting projectors which are to perform very different function combinations from among those mentioned above. Even if the direct management of the whole lighting system is entrusted to skilled personnel, situations can occur that can not be overcome by human intervention. As such lighting projectors are very often mounted by hanging the same from scaffoldings a heights even of 6-7 m, it is evident that a number of difficulties are met with when said projectors require direct personal intervention. Indeed, under such circumstances it is necessary for the operators to go to the top of the scaffoldings or to employ hoisting cranes in order to get to the projectors. Mounting the lighting projectors at floor level gives rise to problems of other kinds but equally hard to solve, for example problems in connection with circuit complications, junction and disjunction operations, check operations, safety devices and the like.

According to this inventi n there is provided a lighting apparatus comprising a lighting projector having m vable members for performing various functi ns and m tor means for driving the m vable members, in which the control of the motor means is effected by m ans of a remote contr l system f the pr portional

type, the system comprising a control transmission unit incorporating control members which can be mechanically operated and which supply control signals proportional to their mechanical operation, and a control signal receiver unit that controls the motor means to operate the movable members of the lighting projector to an extent proportional to the mechanical operation of the control members of the transmission unit.

Preferably the remote control is by means of radio.

The apparatus of the present invention gives a double series of advantages that stem on one side from the fact of remotely controlling the motions of the lighting projector and, on the other side, from the fact that the control system employed is of the proportional type, in which there is correspondence between the position of the control member (i.e. a slider or a knob on the transmitter) and the position of the controlled member.

As is well known, a lighting manager who is in charge of a whole lighting system which among other thing includes lighting projectors as discussed above, works commonly from a self-contained console that is similar to the director's console. Though the lighting manager has all the needed control devices at his disposal on his console, because of his position he is limited in his actions. Such limitation is not a result of structural features, but results from the fact that although the arrangement of the lighting system and the times of operation have been studied previously, the lighting manager is generally far from the scene being lit so that he cannot follow in real time the effects of the control signals he sends from his console. Moreover, there are extemporary situations that cannot be foreseen because they are of a random kind, and which sometimes cannot be reacted to immediately because he is too far from the live scene.

The remote control arrangement of the present invention overcomes these disadvantages by placing a control box at the disposal of the lighting manager (which control box can be a very compact unit and can be miniaturised) which give the lighting manager the possibility of making any adjustment or regulation he wants while being at the position of the action being lit. Under certain circumstances, for instance in the case of close shots on details or on the characters of a play, he can follow the shot almost "with the same eye" as the film camera and fr m any angle.

Moreover, th p ssibility is obtained of remotely driving the c nsole itself direct from the positon f the action being lit thus making full use of the possibility for the lighting manager to estimat and control and correct any situations that may arise even if sudden and unexpected.

The advantages stemming from the use of a remote c ntr l system of the proportional type, result from the correspondence that such radio control system gives between the positions of the control members and those of the members being controlled. An operator in charge of the control unit after initially setting up the apparatus, need not see the controlled member in order to know the position of the same, since once the apparatus has been put in operation the operator knows the condition of any controlled member, so that the state is known of all functions of the lighting projector, from the state of the control members on the control or transmission box.

Preferably a friction clutch is associated with each function or motion mentioned above and thus with each movable or utilization member, the friction clutch being arranged between the member and its driving motor. In such way, transmission of motion from the motor to the member is possible while maintaining the independence of the motor from the condition of the member when necessary, for example in order to avoid attempting to force the member beyond the end of a stroke.

A potentiometer can be associated with each movable member, a part of the potentiometer (the movable contact or the resistive track) being coupled to the movable member so that the potentiometer gives an output proportional to the position of the movable member.

The logical arrangement of the motor (M), the movable or utilization member (U), friction clutch (E) and potentiometer (P) is according to the scheme:

M—F—U—P

The control members of the control box can also act on potentiometers which thus supply outputs proportional to the positions of the control members. Further details concerning proportional radio control are not necessary because such apparatus is well known to those who are skilled in the art.

The shape and organization of the control box and of the control members provided on it are of particular importance. The use of a knob in the form of a rotatable lever is prefered for the rotation motion of the hood; a stick control is prefered for the combined motions of "tilt"and "pan"; a slider control is prefered for the "focus" motion; and four slider control members are prefered for the movement of the niggers. Preferably the four slider control members f r the niggers are arranged crosswise so as t giv a spatial parallel between each contr l member and its associated nigger.

As regards supplying power to the driving motors, the motors can be of a type already known per se, and they can be chosen, for instance, on the basis f the speed with which the various functions are to be per-

formed. The ch ic of the power f the motors affects the design of the receiv r-feeder unit. The motors can be battery supplied, or they can be supplied direct form the supply mains, with the aid of transformers for voltage matching.

This invention will now be described by way of example with reference to the drawings, in which:

Figure 1 shows a simplified scheme of a radio control transmitter for use in apparatus according to the present invention;

Figure 2 shows the front panel of a control box;

Figure 3 shows schematically a receiver assembly for perfoming all movements of a lighting projector;

Figure 4 shows a partial front view of a lighting projector together with the driving arrangement for niggers thereon;

Figure 4A shows a detailed view of the driving arrangement of Figure 4;

Figure 5 shows a side view of a lighting projector with the driving arrangement for perfoming the "focus" movement;

Figure 5A shows a detailed view of the transmission means for the "focus" movement, the view being a cross-sectional view taken along the ling G-G in Figure 5;

Figure 6 shows a front view of a lighting projector with the driving arrangement for rotation of the hood;

Figure 6A shows a detailed view of the driving arrangement for the rotation of the hood;

Figure 6B shows a cross-sectional view along the line A-A in Figure 6A;

Figure 7 shows a side view of the suspension system of a lighting projector with two driving arrangements for the "tilt" and "pan" movements;

Figures 7A and 7B show a side view and a top view respectively of the lighting projector for illustrating the "tilt" and "pan" movements;

Figure 8 shows a partial cross-sectional view of an inverted U arm for suspending a lighting projector; and

Figure 9 shows a cross-sectional view along the line A-A in Figure 8.

Figure 1 illustrates a transmitter, of a conventional well known per se type, which has been adapted for performing the functions necessary in an apparatus according to the present invention. It shows eight control members symbolized by eight potentiometers each of which supplies a control signal proportional to its shift. Four control members are provided for opening and cl sing m vements f the niggers; a control member for r tati n of the hood; a c ntrol member f r the adjustment of the focus, comprising also switching fr m sp t or c ncentrated light to s ft or diffused light; and a combined control member for the "pan" and "tilt" movements.

The ight control members menti n d abov are c nnected to an enc der and thence to a radio frequency transmitter which has a 12 V d.c. feeder.

With reference now to Figure 2, this shows a practical arrangement of such control members on the control box panel. In an upper part on the left there is a combined control member for the tilt and pan movements. Such control member is in the form of a stick control so as to obtain the possibility of performing any combination of the two rotation and tilt motions. In the lower part on the left there is a control member for rotation of the hood, in the form of a lever with a rotation of 180°. In the lower part on the left there is provided a control member for adjustment of the focus, this member being in the form of a linear slider. Such a control member gives the possibility of performing a combined motion of rotation of the mirror and of shift of the carriage that supports the bulb as described above. The lighting projector being described is of the double function type, i.e., it is able to supply a spot or concentrated lighting type or a soft or diffused lighting type. In order to swith from one lighting type to the other, the rotation of the concave mirror and the adjustment of the position of the carriage that supports the bulb is carried out.

As can be seen in Figure 2, the control panel has control members for the niggers. The four control members for the operation of the four niggers are shown in the form of four sliders that are shiftable between two limiting positions of 0° and 180°, independently for each of the four niggers. In order to obtain an ideal spatial parallel between the four control sliders and the respective four niggers, the sliders can otherwise be arranged crosswise, as the niggers on the lighting projectors are arranged crosswise.

With reference now to Figure 3, this shows a receiver mounted on a lighting projector. The receiver comprises a detector unit that includes its feeder unit, the detector unit being connected to a decoding unit (synchronisation) which drives through eight comparators and eight inverter amplifiers eight separate and independent motors for carrying out the movements or functions discussed above. According to proportional radio control techniques, potentiometers are respectively associated to the moveable members moved by the motors, the potentiometers supplying an output proportional to the position taken by the movable members. The potentiometer outputs are fed to second inputs of the comparators that receive, as can be seen from the preceding disclosure and fr m Figure 3, the output contr l signals from the decoding unit, such signals being received by the comparat rs at th ir first inputs. As the decoder supplies signals pr portional to the positions tak n by the control members of the transmitter, the compara-

t rs supply the inverter amplifiers with a driving action proportional to the difference between the input signals applied to the comparators. When such difference is of zero value, the driving action is also zero. Thus a movement is obtained of the various driven members, I.e. of the hood, the niggers, and so on, closely corresponding to the movement of the control members.

Thus, it can be easily understood that, when the apparatus is operating, the operator at the control box need not see the positions taken instant by instant by the various movable members of the lighting projector or the conditions of the projector itself, because such functions are precisely those which can be deducted from the positions taken at the given instant by the control members of the control box.

If any manual motion is to be performed at any moment, by forcing the friction clutches that disengage the movable members from their respective motors, once the forcing action is over (from the electronic viewpoint this means the unbalancing of the inputs of the comparator that is associated with the function of interest), the movable member returns automatically to the position determined by the respective control member at the control box (this setting to zero the difference between the input signals to the comparator). This means also that whatever the condition and the positon of the whole lighting projector as well as of the whole movable members system of the same when the entire system is deactivated, at the moment when the system itself is put into operation the lighting projector and its movable members will take on automatically the conditions set at the control box.

With reference now to Figures 4 and 4A, these show the driving arrangement of the niggers. Motor M drives through an articulated drive 41 shaft 40 on which a nigger is mounted. Disengagement friction clutches F are arranged between the nigger and the motor being arranged between the shaft 40 and the nigger at it hinge points. The associated potentiometer P is connected directly to the nigger in order to realized the follow-up link of the potentiometer adjustment with respect to the position of the nigger. Obviously, identical driving assemblies are provided for the four niggers With reference to Figures 5 and 5A, the focus function driving arrangement is here shown in detail. As can be seen, a small motor M drives a shaft 53 through a friction clutch F and a pair of ring bevel gears 51, 52, the shaft 53 determining the rotation motion of a mirror and th translation motion of a carriage that supports a bulb. The friction clutch F comprises pressure elastic discs and friction material discs, similarly to the other fricti n clutches associates with other movable members of the lighting projector, for instance that shown in Figure 9. The p tentiometer P that is shown schematically as connected to the shaft 53 comprises a slider potetiometer whose sliding member is integrally connected to the translatable carriage.

With reference now to Figures 6, 6A and 6B, the driving arrangement is illustrated for rotation of the hood. As already mentioned above, the hood assembly (the niggers, though capable of independent movement, being part of such assembly) comprises a circular framework 60 bearing a toothed ring 61. A small motor M carries on its output shaft a ring bevel gear 62 engaging with a ring bevel gear 63 mounted on a shaft 64. The shaft 64 drives through a toothed wheel 65 a toothed ring 61 as well as the rotable framework 60 of the hood. A friction clutch F is provided, which comprises pressure discs 66 and friction rings 67.

The potentiometer to be connected with the movable or utilization member is symbolized with a block P and it is of the circular type, i.e., of the rotation type, and is connected to the toothed ring 6, or to the hood ring by means of a suitable reduction gear so that a full travel of the potentiometer corresponds to a full rotation of the ring. To that end the potentiometer P can be connected directly to the toothed wheel 65 through a toothed wheel 68. The transmission of motion must occur with a suitable reduction because a full travel of the potentiometer must correspond to a single rotation of the hood ring.

With reference now to Figures 7, 7A and 7B the inclining motion or "tilt" and the panoramic motion or "pan" will be briefly disclosed. As can be seen, the lighting projector is pivoted at the ends of two arms 71 and 72, which are arranged so as to form an inverted U that is hanging from its central point so that it can rotate about its longitudinal axis. The "tilt" is the inclining motion of the lighting projector about the axis x-x defined by its two pivoting points at the ends of the inverted U. The "pan" is the panoramic rotation movement of the lighting projector together with its suspension fork about the suspension axis y.

The motors for pan and tilt are mounted on a lateral plate 73. The tilt motor M carries on its output shaft 74 a worm gear 75 that engages with a toothed wheel 76 whose axis 77 is integral with the lighting projector body. Rotation of the tilt motor thus causes rotation of the lighting projector in one direction or the other according to the "tilt" arrow, through the c upling w rm gear 75—toothed wheel 76 - axis 77. The necessary disengagement friction clutch F is inserted between the t othed wheel 76 and the axis 77. The associated potentiometer is of the circular type and is connected to axis 77.

As regards the "pan" or panoramic motion, it can be seen that th "pan" motor transmits

its rotation m ti n to a flexible cable 80 h used whithin the arm 71 (Figures 7 and 8) by means of two direct drive toothed wheels 78, 79. The flexible cable 80 which is rigid in rotation, transmits the rotation motion to a shaft 81 carrying a worm gear 82. As can be seen in Figure 9, the worm gear 82 engages with a toothed wheel 90 which is linked to the fixed structure by means of a friction clutch F comprising pressure elastic discs 91 and friction material discs 92. Rotation of the pan motor thus involves rotation of the two arms 71 and 72 about the axis Y. Such rotation is determined by the "screwing" of the worm gear 82 along the circumference of the toothed wheel 90 whereby the rotation can cover a full 360° arc. The potentiometer symbolically shown a P is connected to a member 93 representing the movable or the utilization member.

CLAIMS

1. A lighting apparatus comprising a lighting projector having movable members for performing various functions and motor means for driving the movable members, in which the control of the motor means is affected by means of a remote control system of the proportional type, the system comprising a control transmission unit incorporating control members which can be mechanically operated and which supply control signals proportional to their mechanical operation, and a control signal receiver unit that controls the motor means to operate the movable members of the lighting projector to an extent proportional to the mechanical operation of the control members of the transmission unit.

2. A lighting apparatus according to Claim 1, in which the motor means are electric motors which are arranged to transmit movement to the moveable members through sliding friction clutch couplings.

3. A lighting apparatus accoridng to Claim 1 or Claim 2, in which the remote control system is a radio control system.

4. A lighting apparatus according to Claim 3 in which the transmission unit comprises a radio transmitter and an encoder that receives signals from control members each of which comprises a mechanical member acting on a potentiometer.

5. A lighting apparatus according to Claim 4, in which mechanical members for pan and tilt movements of the lighing projector are combined into a single member in the form of a stick control member capable of rotation and inclination movements and acting n tw separate potentiometers.

6. A lighting apparatus according t Claim 4 r Claim 5, in which a mechanical member for effecting r tation f a hood of the lighitng pr jector c mprises a knob that can be turned thr ugh a 180° arc.

7. A lighting apparatus according to Claim 5 or Claim 6, in which a mechanical member for f cusing the lighting projector is a linear slider member.

8. A lighting apparatus according to any one of Claims 4 to 7, in which mechanical members for operating niggers on the lighting projector are four linear sliders.

9. A lighting apparatus according to Claim 2 or any one of Claims 3 to 8 as dependent upon Claim 2, in which the control signal receiving unit comprises a detector unit connected to a decoding unit that acts on first inputs of a series of comparators whose output signals are passed through respective inverter-amplifiers to control the electric motors for operating the movable members of the lighting projector, the movable members having associated therewith feedback means comprising potentiometers which feed second inputs of the comparators with signals proportional to the movements of the movable members.

10. A lighting apparatus according to Claim 9 as dependent upon Claim 8, in which operation of the niggers is carried out by the associated motor through an articulated motion transmission means, each nigger being mounted on a shaft with a friction clutch arranged between the shaft and the nigger at the hinge points, feedback potentiometers being connected directly to the niggers.

11. A lighting apparatus according to Claim 9 as dependent upon Claim 7, in which the focussing operation is carried out by the associated motor through a pair of bevel gears whose output shaft causes a combined motion of mirror rotation and translation motion of a carriage that supports the bulb in the lighting projector, the feedback potentiometer being connected to the carriage.

12. A lighing apparatus according to Claim 9 as dependent upon Claim 6, in which hood rotation is carried out by means of the associated motor through a pair of bevel gears and a toothed wheel that engages with a toothed ring carried by the hood, a friction clutch being arranged between the bevel gears and the toothed wheel, and the feedback potentiometer being operated by means of the toothed ring.

13. A lighting apparatus according to Claim 12, in which a full movement of the feedback potentiometer is obtained with a full rotation of the toothed ring carried by the hood.

14. A lighting apparatus according to Claim 9, in which the lighting projector is mounted by hinges at the ends of two arms that form an inverted U-shape suspended from its central point s that it can rotate about its longitudinal axis, m tors f r tilt and pan motions f the lighting projector being integral with a first one f the arms, the driving action for tilt movement being transmitted by the ass ciated m tor through a w rm screw-toothed wheel pair t the piv ting axis f the lighting projec-

tor on the arm, a friction clutch being arranged between the toothed wheel and the pivoting axis, and the feedback potentiometer being connected to the pivoting axis.

15. A lighting apparatus according to Claim 14, in which the driving action for pan movement is transmitted by the associated motor through a pair of toothed wheels to a flexible cable which is rigid in rotation motion and is housed in said first arm, the cable having at one end a helical screw that engages with a toothed wheel connected to a non-rotatable part of the lighting projector, a friction clutch being arranged between the toothed wheel and the non-rotatable part of the lighting projector, and the feedback potentiometer being connected to a rotatable part of the lighting projector.

16. A lighting apparatus substantially as hereinbefore described with reference to the drawings.

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